REMARKS

All the claims submitted for examination in this application have been rejected on substantive grounds. Applicants have amended their claims and respectfully submit that all the claims currently in this application are patentable over the rejection of record.

Claims 1, 3-7, 9-13 and 18, all the claims submitted for examination in this application, have been rejected on substantive grounds, under 35 U.S.C. §103(a), as being unpatentable over U.S. Patent Application Publication No. US 2002/0052125 to Shaffer, II et al. taken in view of U.S. Patent 6,576,345 to Van Cleemput et al. and U.S. Patent 5,908,510 to McCullough et al.

The Official Action avers that Shaffer, II et al. discloses a process of forming an etched, coated semiconductor device which includes the step of removing impurities. Specifically, the process taught by Shaffer, II et al. comprises disposing a low dielectric constant curable organic polymeric film, generally as a multilayer film, on a electrically conductive surface of a semiconductor substrate device; curing the film layer or layers; and heating the film layers in a baking step to remove impurities therefrom. The Official Action submits that the Shaffer, II et al. film may be a polyarylene resin.

The Official Action admits that the claims of the present application all require that the semiconductor device and the applied film disposed thereon be contacted with supercritical carbon dioxide effective to remove solvents, unreacted monomers and byproducts of curing, steps outside the scope of the Shaffer, II et al.. To overcome this important distinction, the Official Action applies two secondary references, the first of which is McCullough et al. McCullough et al., the Official Action submits, teaches the

removal of residue from surfaces of semiconductor devices. Since these surfaces may include etched and patterned composites having both silicon and polymeric layers and since these surfaces are contacted with supercritical carbon dioxide and optional additives, and in further view of the contact occurring at elevated heating temperatures, the Official Action concludes that this treatment may effect the curing of film layers on a semiconductor substrate. Furthermore, the Official Action argues that the semiconductor devices cleaned by supercritical carbon dioxide in the McCullough et al. disclosure may included patterned film structures comprised on low dielectric constant polymers such as polyimide, as defined as "preprocessed."

The Official Action further avers that the second secondary reference, Van Cleemput et al., teaches the heating and reacting of monomers of a low dielectric, thin film polymeric film, which is applied to a conductor substrate device, followed by contacting the film and substrate with supercritical carbon dioxide to remove residual solvent, unreacted monomer and byproducts of the heating and curing reaction of the film.

The Official Action thus concludes that it would be obvious to one of ordinary skill in the art to modify the Shaffer, II et al. process by contacting the cured and coated semiconductor device with supercritical carbon dioxide to remove unreacted monomer, solvent and reaction or curing stage byproducts as taught or suggested by Van Cleemput et al. and McCullough et al.

Applicants address this allegation of obviousness by the combined teaching of Shaffer, II et al., Van Cleemput et al. and McCullough et al. by initially observing that the principal Shaffer, II et al. disclosure is totally distinguished from all the claims of the

present application. This is so insofar as Shaffer, II et al., although directed to a process of forming an etched, coated semiconductor device followed by removal of impurities therefrom, does not so much as suggest the critical final step of the process of the sole independent claim currently in this application, Claim 1. That is, nothing in Shaffer, II et al. so much as hints at contacting a cured polyarylene resin film, disposed on a semiconductor device, with supercritical carbon dioxide whereby residual solvents, unreacted monomers and byproducts of curing are removed.

To overcome this failing the Official Action applies either of two secondary references. The first of these is the newly cited Van Cleemput et al. patent which is directed to a method of forming a dielectric layer on an integrated circuit wherein a supercritical fluid is utilized to dissolve precursor molecules, deliver solute or suspended molecules, serve as a reaction medium for reaction of the molecules, and to act as a transport medium to remove unwanted materials from the deposited dielectric film, substrate and reaction vessel. It is the latter function that is relied upon in supplementing the inadequacy of the principal Shaffer, II et al. disclosure.

The claims of the present application, it is emphasized, is directed to a process of removing impurities from a cured low dielectric constant organic polymeric film which is limited to a curable polyarylene resin film. The Van Cleemput et al. disclosure, as set forth at Col. 5, lines 40-51, wherein the function of the supercritical fluid is set forth, also emphasizes that the invention of that disclosure combines supercritical fluid transport and solvation with inorganic-organic hybrid polymer chemistry to form thin film dielectrics on substrates. (Emphasis added). That paragraph includes the statement that the inorganic-organic hybrid polymer chemistry involves caged-siloxanes. The caged-

siloxanes are used as precursors to form porous polymeric low-k thin film dielectrics. As such, the teaching of Van Cleemput et al. is directed to the use of a supercritical fluid in transmitting materials through a porous thin film dielectric which is a caged siloxane.

The claims of the present application, on the other hand, are not limited to a porous film. Furthermore, the identity of the film of the low k film of the present application is limited to a polyarylene resin film, a polymer totally distinguished from silicon-containing polymers of the type utilized in Van Cleemput et al.

The second secondary reference, McCullough et al., similarly fails to make obvious the claims of the present application which the outstanding Official Action admits is not disclosed by Shaffer, II et al., the principal reference. The Official Action states that McCullough et al. teaches the removal of residue from a precision surface such as a semiconductor. More specifically, the Official Action points to Col. 5, lines 42-46 wherein it is stated that the semiconductor samples that are utilized in the McCullough et al. disclosure are samples subjected to etching techniques and include patterned film structures.

Although the Official Action is correct in observing that the requirement that the semiconductor sample be subjected to reaction ion etching or other etching techniques does not change the fact that the supercritical fluid, such as supercritical carbon dioxide, contacts a patterned film structure, that observation does not also change the fact that that contact with a patterned film structure bears no analogy to contact with a curable polyarylene resin film wherein residual solvents, unreacted monomers and byproducts of curing are removed. That is, there is no disclosure, suggestion or inference that the supercritical fluid, which contacts the patterned film structure, results in the removal of

solvents, unreacted monomers or byproducts of curing, albeit the patterned film structure is obviously cured.

The Official Action makes much of the fact that the conditions extant in McCullough et al. are thermodynamic conditions that emulate curing conditions. Any such emulation is purely coincidental. The thermodynamic conditions present during contact with a supercritical fluid are those conditions necessary to retention of the fluid in the supercritical state. These thermodynamic conditions are clearly in accordance with a temperature and a pressure necessary to maintain carbon dioxide in the supercritical state. There is no disclosure in McCullough et al. that supports the proposition that the conditions under which the supercritical carbon dioxide is added to the film are the conditions necessary for curing of a polyarylene resin.

The second substantive ground of rejection is the rejection of all the claims submitted for examination, Claims 1, 3-7, 9-13 and 18, under 35 U.S.C. §103(a), as being unpatentable over McCullough et al. taken in view of Shaffer, II et al. and Van Cleemput et al.

The Official Action predicates this ground of rejection upon the disclosure in the principal McCullough et al. disclosure of forming a semiconductor substrate or wafer by disposing a low dielectric constant curable polymeric film, such as a polyimide or other polymer, on an electrically conductive surface and then cleaning the film surface by contacting the surface with supercritical carbon dioxide.

The Official Action states that the claims of the present application differ from the teaching of McCullough et al. in that the claims require the film to be cured. To overcome this deficiency in the principal McCullough et al. reference, the Official Action

observes that McCullough et al. additionally teaches that the contact of the supercritical carbon dioxide with the film occurs at significantly elevated heating temperature that may be in a range and for a duration to effect curing of the substrate and film.

Applicants submit that the interpretation of McCullough et al. as an analogous prior art reference, in terms of disclosing the use of supercritical carbon dioxide during curing, is misplaced. The Official Action would rely on the allegation that the thermodynamic conditions associated with supercritical carbon dioxide are similar to the thermodynamic conditions extant during curing of a polyarylene resin. Other than the allegation that elevated the thermodynamic conditions under which supercritical carbon dioxide is added to a patterned film layer in McCullough et al. are the same as curing of a polyarylene film, the proof of which is totally unsubstantiated, there is nothing in McCullough et al. to substantiate it as an analogous prior art reference.

Not only is there no proof that the conditions under which supercritical carbon dioxide is utilized in McCullough et al. corresponds to those conditions extant during curing of a polyarylene film but, in addition, it is necessary to consider the reality of circumstances, in other words, common sense, in deciding in which fields a person of ordinary skill would reasonably be expected to look for a solution to a problem facing an inventor. Where there is no teaching or suggestion that a teaching in a reference would achieve a claimed purpose, that reference is non-analogous art. In re Oetiker, 977 F.2d 1443, 24 USPQ 2d 1443 (Fed. Cir. 1992).

So it is in the present application. The clear teaching of McCullough et al. is the removal of residue caused by RIE or other etching techniques by contact with supercritical carbon dioxide. The claims of the present application are directed to the

removal of residual materials associated with the curing of a polyarylene resin. The teaching of McCullough et al. is clearly non-analogous to the claims of the present application. An observation made in Oetiker is particularly pertinent to the facts of the present case. In Oetiker it is stated that "[P]atent examination is necessarily conducted by hindsight, with complete knowledge of the applicant's invention, and the courts have recognized the subjective aspects of determining whether an inventor would reasonably be motivated to go to the field in which the examiner found the reference, in order to solve the problem confronting the inventor." Clearly, in the present case, the applied reference is not analogous.

The application of the secondary Shaffer, II et al. reference is also misplaced. Shaffer, II et al. teaches curing of a polymeric film on a semiconductor substrate. However, Shaffer, II et al., as stated above, has no relevance to the teaching of McCullough et al. given the total absence of any use of supercritical carbon dioxide in the Shaffer, II et al. curing operation.

The second secondary reference, Van Cleemput et al., teaches the heating and reaction of monomers to form low dielectric constant thin films followed by contact with supercritical carbon dioxide to remove unwanted materials from the deposited dielectric film substrate and reaction vessel.

Clearly, in view of the absence of any suggestion in McCullough et al. of utilizing supercritical carbon dioxide in the curing of any film patterned surface on a precision surface, the combination of Van Cleemput et al. with McCullough et al. is nothing more than the utilization of the present application as a reference against itself. There is no relation between removal of residue from a long since cured film surface and a process in

which a polymeric film is cured on that surface. As such, the combined teaching of McCullough et al. taken with Shaffer, II et al. or Van Cleemput et al. does not make unpatentable any of the claims currently in this application. Reconsideration and removal of the two substantive grounds of rejections, in view of the above remarks, are thus deemed appropriate. Such action is respectfully urged.

It is noted that the only amendment to the claims, made herein after final rejection, is the cancellation of Claims 9-12 and 18. Insofar as the cancellation of claims, after final rejection, is always appropriate, entrance of the instant amendment is justified. Such entrance is solicited.

The above amendment and remarks establish the patentability of all the claims currently in this application. Notice of Allowance and passage to issue these claims, Claims 1, 3-7 and 13-17, is therefore respectfully solicited.

Respectfully submitted,

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